(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 298 426 B1**

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **28.09.94**

(51) Int. Cl.5: **C03B 23/035**, C03B 23/03

(21) Application number: **88110719.7**

(22) Date of filing: **05.07.88**

(54) **Glass sheet bending apparatus.**

(30) Priority: **07.07.87 JP 169393/87**

(43) Date of publication of application:
11.01.89 Bulletin 89/02

(45) Publication of the grant of the patent:
28.09.94 Bulletin 94/39

(84) Designated Contracting States:
DE FR GB IT

(56) References cited:
EP-A- 0 139 524
EP-A- 0 211 755
US-A- 4 386 952
US-A- 4 661 141
EP-A- 0 169 770
EP-A- 0 262 046
US-A- 4 578 103

(73) Proprietor: **ASAHI GLASS COMPANY LTD.**
No. 1-2, Marunouchi 2-chome
Chiyoda-ku, Tokyo (JP)

(72) Inventor: **Kudo, Masashi**
7-21-2-235, Kitaterao
Tsurumi-ku
Yokohama-shi Kanagawa-ken (JP)

(74) Representative: **Wächtershäuser, Günter, Prof. Dr.**
Patentanwalt
Tal 29
D-80331 München (DE)

Description

The present invention relates to a glass sheet bending apparatus for bending a glass sheet deep-bending a side of said glass sheet at a bending station in a heating furnace.

A horizontal furnace pressing system as a system for bending a glass sheet is known from the Japanese Unexamined Patent Publication 132528/1986. In such a system, a glass sheet is heated at a temperature of about 600•C-650•C at a bend-processing stage in a heating furnace to bend said glass sheet into a given curved form; the curved glass sheet is transferred to a cooling stage outside the heating furnace; cooling air is blasted to the curved glass sheet at the cooling stage to temper it, and then the tempered curved glass sheet is removed.

In the above-mentioned system wherein a glass sheet is bent at a high temperature in the heating furnace, it is possible to bend the glass sheet to have a complicated shape because the glass sheet is easily deformed under a high temperature condition in comparison with a system in which a glass sheet is bent outside a heating furnace. Further, the system has the advantage that since the glass sheet is bent in the heating furnace, reduction in temperature is small during the bending operation in comparison with the system in which the bending operation is carried out outside the heating furnace. Accordingly, when the glass sheet after bending is subjected to a cooling operation to temper it, the initial temperature can be increased to thereby be able to give a sufficient strength.

Furthermore a conventional glass sheet bending apparatus used for the horizontal furnace pressing system is known, for instance from the Japanese Unexamined Patent Publication 178329/1985. Such a bending apparatus is constituted in such a manner that as shown in Figure 22, a conveyor 3 is arranged in a heating furnace 2 to transfer a glass sheet 1 to a bending stage ST while keeping its horizontal posture; a vacuum suction type mold 4 having a shaping surface which corresponds to the shape of the glass sheet 1 after shaping is disposed so as to be vertically movable at a place corresponding to the bend-processing stage ST; a lift jet device 5 is disposed below the bend-processing stage ST to blow up an air stream; and a press ring 6 is arranged in the heating furnace 2 adjacent to the bend-processing stage ST so as to be capable of forwarding and retracting, whereby the glass sheet 1 is bent in the bend-proceesing station ST. Said pressing ring 6, for instance, comprises a fixed press ring portion 6a having a radius of curvature corresponding to a generally curved surface 4a of the mold 4 and a movable press ring portion 6b having a radius of curvature corresponding to a deep-bending surface 4d of the mold 4 which is connected to the side portion of the fixed press ring portion 6a by a hinge 7.

In the known glass sheet bending apparatus, when a heated glass sheet 1 is positioned in a flat shape in the bend-processing station ST, the mold 4 is descended onto the glass sheet 1, and then air is blown from the lift jet in association with a sucking action by the mold 4. Then, the glass sheet 1 is preliminarily shaped on the generaly curved surface 4a of the mold 4. The mold 4 is ascended while it keeps the glass sheet 1 thereon. Then, the pressing ring 6 is forwarded from its waiting position to the bend-processing station ST so that the movable pressing ring portion 6b of the pressing ring 6 presses the side of the glass plate 1 onto the deep-bending surface 4b of the mold 4. As a result, the glass sheet 1 is finally shaped so as to have the finally shaped configuration.

However, the bending of the side portion of the glass sheet 1 by the above-mentioned conventional glass sheet bending apparatus causes relative slide-contact between the movable pressing ring portion 6d and the side portion of the glass sheet 1 because the radius of curvature of the deep-bending surface 4b is relatively small. Accordingly scratches may be resulting in the side portion of the glass sheet 1 with which the moveable pressing ring portion 6d is in contact resulting in reduction of the quality of the shaped glass sheet 1.

Furthermore a glass sheet bending system is disclosed in the US-A-4 386 952 which includes a compressed bending unit located above a horizontal conveyor on which glass sheets are heated within a furnace of the system. A downwardly facing curved surface of a holder above said conveyor receives a heated glass sheet from the conveyor for bending. Compressed gas fed through outlets of the bending unit provides inclined gas jets directed in generally perpendicular relationship to the holder surface with a sufficient intensity to bend the glass sheet on the holder to the curved shape of its surface. The conveyor of the system is preferably of the roller type including spaced rolls and the bending unit is disclosed as including a pair of supply conduits extending upwardly between the rolls to supply compressed gas to a pan of delivery conduits which define the outlets. A blow-up unit, a vacuum drawing unit for the holder, and a vertically operable actuator for the holder preferably cooperate with the bending unit. A curved mold is moved to below to the holder to receive the bent glass sheet and further bending of the glass sheet preferably taxes place on the mold under the operation of gravity. The system also includes a quench unit to which the mold moves the bent glass sheet for tempering in order to improve its

mechanical properties.

It is an object of the present invention to provide a glass sheet bending apparatus capable of deep-bending a side portion of a glass sheet while at least substantially avoiding occurance of scratches in the side portion which causes reduction of the quality.

The foregoing and the other objects of the present invention have been attained by a glass sheet bending apparatus for bending a glass sheet and deep-bending a side of said glass sheet according to claim 1.

It is another aspect of the present invention, to provide a glass sheet bending apparatus having a press-bending means operable after finishing a bending operation by a blow-bending means so that a side portion of a glass sheet is pressed to the deep-bending surface, in addition to the structural elements as defined in the above-mentioned invention.

The transferring means of the invention is not limited to a continuous type conveyor such as a number of transferring rollers or a transferring belt having heat resistance, but it may be a truck movable between the bend-processing stage and an intially setting position as far as it can transfer a heated glass sheet. The transferring means may be provided with a position determining unit which is constructed in that, for instance, the glass sheet is transferred to a position in the bend-processing stage by using a control system.

The mold may be designed as desired. However, it has to be provided with a shaping surface corresponding to the final configuration of the glass sheet by using a material durable to a shaping temperature in the heating furnace (about 600°C-650°C). As such heat resistant material, a sheet material made of stainless steel may be used. In this case, a plurality of pieces of stainless steel each having a radius of curvature corresponding to parts of the deep-bending surface of the mold are joined followed by grinding the surface of the joined plates for finishing. Ceramics having heat resistance properties may be used, too. In consideration of thermal deformation and processability after finishing, it is preferable that the mold is formed by casting a cast iron having a high heat resistance such as stainless steel, heat-resistance steel, a high manganese cast iron, a high metal alloy and so on. Further, in consideration of light weight property, the mold may be formed by a heat resistance inorganic material such as calcium silicate, fiber ceramics, a light castable ceramic material.

The mold should be designed so that the rigidity of the shaping surface is maintained by forming reinforcing ribs on the backside of the mold or by thickening the wall of the mold. Further, a coating layer made of a material such as glass fibers or another ceramic fibers may be incorporated in the shaping surface of the mold so as to obtain the function as a buffer layer.

The provisionally shaping means can be designed as desired. However, the glass sheet should be made in close-contact with the generally curved surface except for the deep-bending surface. For instance, when a hanging type mold is used, the provisionally shaping means may be provided with a sucking means for sucking a glass sheet to the mold and a lifting means for forcing the glass sheet toward the mold. When a stationary type mold is used, the mold may be provided with a sucking means.

The blow-bending means may be provided with a number of blowing nozzles or a single blowing duct as far as a blowing force is applied to the side of the glass sheet to bend it deeply. Such device may be installed at any desired position on the mold or the other element as far as it does not hinder the shaping operation to the glass sheet.

As to the press-bending means in the invention, it may be designed as desired as far as the portion of the glass sheet to be deep-bent is strongly forced toward the mold. However, from the standpoint that the shaped glass sheet is free from damage such as a scratch, it is desired to utilize a partially movable type or fixed ring type press-bending device wherein only the edge portion of the glass sheet which is deep-bent is uniformly forced to the mold.

Figure 1 is a plane view showing schematically an embodiment of the glass sheet bending apparatus according to the present invention;

Figure 2 is a cross-sectional view taken along a line II-II in Figure 1;

Figure 3 is a cross-sectional view taken along a line III-III in Figure 1;

Figure 4 is a front view partly cross-sectioned of an embodiment of the glass sheet bending apparatus according to the present invention;

Figure 5 is a cross-sectional view taken along a line V-V in Figure 4;

Figure 6 is a diagram viewed from the direction of VI in Figure 4;

Figure 7 is a diagram showing in detail of the part indicated by VII in Figure 4;

Figures 8a-8c are respectively diagrams showing the operations of the glass sheet bending apparatus of the present invention;

Figure 9 is a diagram showing the operation by the blow-bending means used for an embodiment of the present invention;

Figures 10a and 10b are respectively diagrams showing the operation of bending a glass sheet at a cooling stage according to the present invention;

Figure 11 is a plane view showing a second embodiment of the glass sheet bending apparatus according to the present invention;
Figure 12 is a cross-sectional view taken along a line XII-XII in Figure 11;
Figure 13 is a diagram showing in detail the portion indicated by XIII in Figure 11;
Figure 14 is a front view partly cross-sectioned of an embodiment of the glass sheet bending apparatus according to the present invention;
Figure 15 is a diagram showing in detail the portion indicated by XV in Figure 14;
Figure 16 is a front view partly cross-sectioned of another embodiment of the glass sheet bending apparatus of the present invention;
Figure 17 is a cross-sectional view taken along a line XVII-XVII in Figure 16;
Figure 18 ia a diagram showing in detail the portion indicated by XVIII in Figure 16;
Figure 19 is a front view partly cross sectioned of still another embodiment of the glass sheet bending apparatus according to the present invention;
Figure 20 is a cross-sectional view taken along a line XX-XX in Figure 19;
Figure 21 is a diagram showing in detail the portion indicated by XXI in Figure 19; and
Figure 22 is a diagram showing an example of a conventional glass sheet bending apparatus.

Referring to the drawings, wherein the same reference numerals designate the same or corresponding parts througout the several views, and more particularly to Figures 1 to 3 thereof, there is shown a first embodiment of the glass sheet bending apparatus for deep-bending both sides of a glass sheet in a heating furnace.

In Figures 1 to 3, a glass sheet 1 is transferred to a bend-processing stage ST by a conveyor 3 consisting of a number of transferring rollers which are provided in a heating furnace 2. A bending mold 10 for bend-shaping the glass sheet 1 is provided at an upper part in the bend-processing stage ST, and a provisionally shaping device 20 is placed in the bend-processing stage ST to provisionally shaping the glass sheet 1. Blow-bending devices 30 are also provided to effect deep-bending of both sides of the provisionally shaped glass sheet 1. A cool-processing stage ST 1 is provided outside the heating furnace 2 adjacent to the bend-processing stage ST to cool and temper the curved glass plate 1 which is bent by the bending device. Cooling devices 60 are respectively disposed at upper and lower parts in the cool-processing stage ST 1. The cooling devices 60 are respectively communicated with a blower 62. A quenching ring 61 having a shape corresponding to the shape of the curved glass plate 1 is disposed so as to be forwarded and retracted between the bend-processing stage ST and the cool-processing stage ST 1, whereby the curved glass sheet 1 shaped by the bending device is transferred to the cool-processing stage ST 1.

In this embodiment, the mold 10 is fabricated by joining several pieces of stainless steel plates having a heat resistant temperature of about 700°C for instance. The mold 10 is constituted by a cup-shaped mold main body 11 and a back cover plate for closing the opening portion of the mold main body 11 as shown in Figures 4 and 5. The mold 10 is supported by a plurality of supporting rods 14 set up at appropriate positions on the backcover plate 12 so as to be movable in the vertical direction by means of brackets 13.

The mold main body 11 has a shaping surface corresponding to the shape of the glass sheet 1 bend-shaped, which consists of, for instance, a generally curved surface 15a having a gentle radius of curvature corresponding to the central portion of the shaped glass sheet 1 and deep-bent curved surfaces 15d having a small radius of curvature corresponding to both sides of the glass sheet 1. The mold 10 is descended at a time in that a glass sheet 1 is set in the bend-processing stage ST; is ascended to the initial position as soon as the provisionally shaping device is 20 actuated; and is maintained at the initial position until a series of bending operationes is finished. In Figure 4, a reference numeral 2a designates a wall of the heating furnace 2.

The provisionally shaping device 20 comprises a lift jet device 21 disposed at the lower part of the bend-processing stage ST and a suction device 25 to cause an air sucking force at the shaping surface 15 in the mold 10. In this embodiment, the lift jet device 21 is constituted by a number of injection nozzles 22 arranged in the region corresponding to the glass sheet 1 when it is set at a predetermined position in the bent-processing stage ST. An air duct 24 communicates each of the injection nozzles 22 with a compressor 23 so that the compressor 23 is operated at a time in that a glass sheet 1 is set in the bend-processing stage ST. On the other hand, the suction device 25 is constructed in that a connecting duct 26 is formed at the central portion of the back cover plate 12 of the mold 10 to be communicated with a vacuum source 27 such as a suction blower (Figure 2); a number of apertures 28 are formed in the shaping surface 15 of the mold main body 11, whereby a sucking effect is obtainable by actuating the vacuum source 27 at the timing that the glass sheet 1 is set in the bend-processing stage ST.

The blow-bending device 30 is so constructed that, as shown in Figures 4 to 7, a T-shaped blowing pipe 33 in which both ends of the T-shaped pipe are closed is connected to the free

end of a pipe 32 which is, in turn, connected to the compressor 31; blowing nozzles 34 are attached with a predetermined pitch (about 25 mm-70 mm) to the blowing pipe 33 in its longitudinal direction, and the blowing pipe is supported by the mold 10 by means of a movable supporting means 35 so that each of the blowing nozzles 34 face the deep-bending surfaces 15d of the mold. In this embodiment, pressure to inject air through the blowing nozzles 34 is determined at, for instance, about 8 kg/cm^2.

A pair of the movable supporting means 35 are provided, each having a supporting arm 36 fixed between a pair of supporting rods 14 of the mold 10. An air cylinder 37 is supported at the base portion of the supporting arm 36 so as to be slightly swingable, and an operating bar 38 is attached to the free end of the piston rod 37a of the air cylinder 37 so as to extend laterally. The operating bar 38 is supported at both ends by means of a pair of links 40 each end of which is pivoted to each frame 39 which is fixed attached to the mold 10, and the blowing pipe with blowing nozzles 34 is attached to the operating bar 38 by means of a pair of supporting brackets 41.

The air cylinder 38 used for this embodiment operates as follows. The air cylinder 37 is actuated for a predetermined time, specifically, a sufficient time (about 2 seconds-6 seconds) to complete deep-bending operations immediately after finishing of the provisionally shaping operations by the provisionally shaping device 20. When the piston rod 37a is determined to be in the retracting position, the blowing nozzles 34 are moved so as to separate from the deep-bending surface 15b of the mold 10 and at a position above the lowermost surface of the mold 10 as indicated by a two-dotted line in Figure 7. When the piston rod 37a of the air cylinder 37 is determined to be in an advanced position, the blowing nozzles 34 are arranged facing the deep-bending surface 15d of the mold 10 as indicated by a solid line in Figure 7. Accordingly, in accordance with the glass sheet bending apparatus of this embodiment, a flat glass sheet 1 is first transferred by the conveyor 3 to a predetermined position in the bend-processing stage ST. Then, the mold 10 is descended onto the flat glass sheet 1 as shown in Figure 8a, and the lift jet device 21 and the suction device 25 which constitute the provisionally shaping device 20 are actuated. Then, the mold 10 is ascended. In this case, there is no danger of interference of the blow-bending device 30 with the glass sheet 1 even when the mold 10 is descended because the blowing nozzles 34 of the blow-bending device 30 are located above the lowermost surface of the mold 10 as shown in Figure 8a.

When the provisionally shaping device 20 is operated, the central portion of the glass sheet 1 is sucked and maintained at the generally curved surface 15a of the mold 10 to be subjected to provisionally shaping as shown in Figure 8b. In this case, since a sufficient blowing force and a sucking force do not act on the side portions of the glass sheet 1, the side portions of the glass sheet 1 may not come in close-contact with the deep-bending surfaces 15d although they approach toward the deep-bending surfaces 15b of the mold 10 as indicated by two-dotted chain line in Figures 8b and 9 (in comparison with the glass sheet having a flat shape as indicated by one-dotted chain line).

Then, the blow-bending device 30 is actuated as shown in Figures 8b and 9. Namely, the piston rod 37a of the air cylinder 37 is extended, and at the same time, the compressor 31 is operated, whereby air is injected from the blowing nozzles 34 disposed at a position opposing the deep-bending surfaces 15b of the mold 10 to the side portions of the glass sheet 1. Then, the side portions of the glass sheet 1 are forced to the deep-bending surfaces 15b without causing defects such as scratches by the blowing force as indicated by a solid line in Figures 8c and 9, whereby the central portion and the side portions of the glass sheet 1 are shaped corresponding to the shaping surface of the mold 9; thus, the bending operations for the glass sheet 1 is finished at this stage.

After finishing the bending operations the glass sheet 1 is separated from the mold 10 as shown in Figures 10a and 10b, and then it is supported by the quench ring 61 and introduced into the cool-processing stage ST 1 outside the heating furnace 2 where it is cooled and tempered by blowing and cooling air by the cooling device 60.

In this embodiment, there are no requirements for the pipe 32 in the blow-bending device 30 except that the pipe 32 has to be movable in its length direction for the ascending and descending operations of the mold 10. The position of the blowing nozzles 34 can be freely adjusted so as to bend deeply the side portions of the glass sheet 1. Therefore, a stable deep-bending operation of the blow-bending device 30 is obtainable.

In this embodiment, it is desirable that compressed air ejected from the blowing nozzles 34 of the blow-bending device 30 and injection nozzles of the lift jet device 21 of the provisionally shaping means 20 is previously heated at a high temperature so as not to cool the glass sheet G by blasted air.

Figures 11 and 12 show a second embodiment of the glass sheet bending apparatus. The basic construction of the second embodiment is the same as the first embodiment except that the apparatus is provided with a press-bending device

which is actuated after the deep-bending operation by the blow-bending device 30.

In the second embodiment, the press-bending device 50 is arranged on a shuttle truck 51 which is movable in the heating furnace 2 between the bend-processing stage ST and a waiting position. As shown in Figures 13 and 14, the press-bending device 50 is constituted by a fixed press ring 52 having the same radius of curvature as the generally curved surface 15a of the mold 10 and a pair of movable press rings 54 which are connected to both sides of the fixed press ring 52 by means of hinges 53 so as to be swingable, and which respectively have the same radius of curvature as the deep-bending surfaces 15d of the mold 10. The movable press rings 54 are moved to perform a swing motion by an actuator (not shown). In the second embodiment, the shuttle truck 51 is moved to the bend-processing stage ST after the operation of the blow-bending device 30 is finished, and the movable press rings 54 are moved toward the deep-bending surfaces 15d of the mold 10 when the shuttle truck 51 is moved to the bend-processing stage ST.

In accordance with the second embodiment, the deep-bending operation is effected by the blow-bending means 30 after the glass sheet 1 is provisionally shaped in the same manner as with the first embodiment. In this case, when the deep-bending surfaces 15b of the mold 10 have an acute curve, it is difficult that the side portions of the glass sheet 1 do not come in close-contact with the deep-bending surfaces 15b. In the second embodiment, however, the movable press rings 54 function to forcibly press the side portions of the glass sheet 1 to the deep-bending surfaces 15b. Accordingly, the side portions of the glass sheet 1 slighty separated from the deep-bending surfaces 15b (as indicated by an two-dotted line in Figure 15) certainly come in close contact with the deep-bending surfaces 15b as indicated by a solid line in Figure 15. In this case, the movable press rings 54 are in contact with the glass sheet 1. However, there is no danger of occurrence of scratches in the side portions of the glass sheet 1 because the quantity of displacement between the movable press rings 54 and the glass sheeet 1 is small.

Figures 16 to 18 show a third embodiment of the present invention. The basic construction of the third embodiment is the same as the second embodiment except that the construction of the blow-bending device 30 is somewhat different from that of the second embodiment.

A piping 45 connected to a compressor (not shown) is arranged on the shuttle truck 51, and a branch piping 46 is connected to the end of the piping 45. At both ends of the branch piping 46, blowing pipes 33 as used for the first and second embodiments are connected. Each of the blowing pipes 33 are fixed to the shuttle truck 51 by means of brackets 47. A number of blowing nozzles 34 are formed in the blowing pipes 33 to be directed to the deep-bending surfaces 15b of the mold 10.

In the third embodiment of the present invention, the gneral construction of the apparatus can be simple because the movable supporting mechanism 35 as used for the first and second embodiments is unnecessary.

Figures 19 to 21 show a fourth embodiment of the present invention. The fourth embodiment has a different blow-bending device 30 as compared to the third embodiment.

In the fourth embodiment, a branch piping 46 is connected to a piping 45 which is in turn, connected to a compressor (not shown). Blowing pipes 33 each having a number of blowing nozzles 34 are respectively connected to the branch piping 46 through respective flexible tubes 48. The blowing pipes 33 are respectively attached to the movable press rings 54 constituting the press-bending device 50 such that the blowing nozzles 34 do not project from the surfaces of the movable press rings 54.

In accordance with the fourth embodiment of the present invention, the angular position of the blowing nozzles 34 can be easily adjusted because the blowing nozzles 34 are arranged close to the deep-bending surfaces 15b in comparison with the third embodiment.

As described above, in accordance with the first and second embodiments of the glass sheet bending apparatus, possibility of occurrence of scratches which may take place between a press-bending means and the side portions of the glass sheet during the deep-bending operations is reduced in comparison with a conventional apparatus in which the side portions of the glass sheet is directly deep-bent by means of the press-bending means; this being effected by blowing compressed air to the side portions of the glass sheet to bend it deeply. Accordingly, the quality of the deep-bent glass sheet can be kept in good condition. Further, the side portions of the glass sheet can certainly be deep-bent even when the side portions of the glass sheet are to be deeply bent because the side portions are pressed by means of the press-bending means after that portions are bent by blowing comressed air.

Claims

1. A glass sheet bending apparatus for bending a glass sheet (1) and deep-bending a side of said glass sheet (1) at a bending station (ST) in a heating furnace (2) which comprises:
a transport means (3) for transporting said

glass sheet (1) through said heating furnace (2) to the bending station (ST) located in the furnace (2) where said glass sheet (1) reaches a temperature capable of processing, while keeping a horizontal posture,
a mold (10) having a curved surface with which said glass sheet (1) is to be bend-shaped, said mold (10) being located in the bending station (ST),
a shaping means for shaping said glass sheet (1) over its full surface in two stages, whereby in the first stage a first bending means (20) presses the glass sheet (1) to the mold (10) except from that part of the sheet that has to be deep-bent, and in the second stage the latter part is pressed by a second bending means (30) comprising blowing nozzles (34) to that part of the mold (10) that provides the deep-bend part of the finished-bend glass sheet (1) by a stream of compressed air streaming from said blowing nozzles (34), wherein said second bending means (30) further comprises at least one movable supporting means (35) movable between an advanced blowing position and a retracted waiting position.

2. The glass sheet bending apparatus according to Claim 1, comprising means for raising said mold (10) in said bending station (ST), means for holding said glass sheet (1) by said mold by vacuum function and means for operating said second bending means (30) so as to bring it in said advanced blowing position and to blow compressed air from said blowing nozzles (34) to said glass sheet when said mold is in the raised position.

3. The glass sheet bending apparatus according to Claim 1, wherein two sets of second bending means (30) are provided at both sides of said mold (10) at the positions corresponding to deep-bending surfaces on said mold (10).

4. The glass sheet bending apparatus according to Claim 1, wherein said movable supporting means (35) comprises a piston rod (37a), an operating bar (38) fixed to the lower end of said piston rod (37a) and extending laterally, said operating bar (38) holding said blowing nozzles (34), and a link pivotally connected to said operating bar (38) at one end and fixed to said mold (10) at the other end, whereby said blowing nozzles (34) come close to or are separated from said mold (10) when said piston rod (37a) is operated.

5. The glass sheet bending apparatus according to Claim 1, wherein said shaping means has a lift jet device (21) arranged at the lower part of said bending station (ST) and a suction device (25) for causing an air-sucking force at the shaping surface on said mold (10).

6. The glass sheet bending apparatus according to Claim 1, comprising a press-bending means (50) which is operated after a bending operation by said shaping means is finished to press a side portion of said glass sheet (1) so as to correspond to said deep-bending surface in said mold (10).

7. The glass sheet bending apparatus according to Claim 6, wherein said shaping means is integrated with said press-bending means (50).

Patentansprüche

1. Glasscheiben-Biegevorrichtung zum Biegen einer Glasscheibe (1) und zum starken Biegen einer Seite der Glasscheibe (1) in einer Biegestation (ST) in einem Heizofen (2), welche Vorrichtung folgendes aufweist:
   - eine Transporteinrichtung (3) zum Transportieren der Glasscheibe (1) durch den Heizofen (2) zu der im Ofen (2) liegenden Biegestation (ST), wo die Glasscheibe (1) eine Temperatur erreicht, in der eine Verarbeitung möglich ist, während sie ihre horizontale Lage beibehält;
   - ein Formwerkzeug (10) mit einer gekrümmten Oberfläche, gemäß der die Glasscheibe (1) zu biegen ist, welches Formwerkzeug (10) in der Biegestation (ST) angeordnet ist;
   - eine Formeinrichtung zum Formen der Glasscheibe (1) über ihre gesamte Fläche in zwei Stufen, wobei in der ersten Stufe eine erste Biegeeinrichtung (20) die Glasscheibe (1) mit Ausnahme desjenigen Teils der Scheibe an das Formwerkzeug (10) drückt, das stark gebogen werden muß, und wobei in der zweiten Stufe der letztere Teil durch eine zweite Biegeeinrichtung (30) mit Ausblasdüsen (34) an demjenigen Teil des Formwerkzeugs (10), der für den stark gebogenen Teil der fertiggebogenen Glasscheibe (1) sorgt, durch einen Strom von aus den Ausblasdüsen (34) ausströmender Druckluft angedrückt wird, wobei die zweite Biegeeinrichtung (30) ferner mindestens eine bewegliche Abstützeinrichtung (35) aufweist, die zwischen einer vorgestellten Blasposition und einer zurückgezogenen

Warteposition verstellbar ist.

2. Glasscheiben-Biegevorrichtung nach Anspruch 1, mit einer Einrichtung zum Anheben des Formwerkzeugs (10) in der Biegestation (ST), einer Einrichtung zum Halten der Glasscheibe (1) durch das Formwerkzeug durch Vakuumwirkung, und einer Einrichtung zum Betätigen der zweiten Biegeeinrichtung (30) in solcher Weise, daß sie in die vorgestellte Blasposition gebracht wird und Druckluft aus den Ausblasdüsen (34) auf die Glasscheibe bläst, wenn sich das Formwerkzeug in der angehobenen Stellung befindet.

3. Glasscheiben-Biegevorrichtung nach Anspruch 1, bei der zwei Sätze zweiter Biegeeinrichtungen (30) zu beiden Seiten des Formwerkzeugs (10) an denjenigen Positionen vorhanden sind, die den stark biegenden Flächen am Formwerkzeug (10) entsprechen.

4. Glasscheiben-Biegevorrichtung nach Anspruch 1, bei der die bewegliche Abstützeinrichtung (35) eine Kolbenstange (37a), einen am unteren Ende der Kolbenstange (37a) angebrachten und sich quer zu dieser erstreckenden Betätigungsstab (38), der die Ausblasdüsen (34) trägt, und eine Verbindung aufweist, die an einem Ende schwenkbar mit dem Betätigungsstab (38) verbunden ist und am anderen Ende am Formwerkzeug (10) befestigt ist, wodurch die Ausblasdüsen (34) dicht an das Formwerkzeug (10) gelangen oder von diesem getrennt werden, wenn die Kolbenstange (37a) betätigt wird.

5. Glasscheiben-Biegevorrichtung nach Anspruch 1, bei der die Formeinrichtung über eine Hebeluftstrahl-Vorrichtung (21), die im unteren Teil der Biegestation (ST) angeordnet ist, und eine Saugvorrichtung (25) verfügt, um an der formgebenden Oberfläche des Formwerkzeugs (10) eine Luftsaugkraft hervorzurufen.

6. Glasscheiben-Biegevorrichtung nach Anspruch 1, mit einer Preß-Biege-Einrichtung (50), die betätigt wird, nachdem der Biegevorgang durch die Formungseinrichtung beendet ist, um so auf einen Seitenabschnitt der Glasscheibe (1) zu drükken, daß er der stark biegenden Fläche am Formwerkzeug (10) entspricht.

7. Glasscheiben-Biegevorrichtung nach Anspruch 6, bei der die Formungseinrichtung integral mit der Preß-Biege-Einrichtung (50) ausgebildet ist.

Revendications

1. Appareil de bombage de feuilles de verre pour bomber une feuille de verre (1) et pour bomber profondément un côté de ladite feuille de verre (1) dans un poste de bombage (ST) situé dans un four de chauffage (2) qui comprend :
des moyens de transport (3) pour transporter ladite feuille de verre (1) à travers ledit four de chauffage (2) jusqu'au poste de bombage (ST) situé dans le four (2) où ladite feuille de verre (1) atteint une température permettant un traitement, tout en gardant une position horizontale,
un moule (10) présentant une surface incurvée avec laquelle ladite feuille de verre (1) doit être bombée, ledit moule (10) étant placé dans le poste de bombage (ST),
des moyens de formage pour former ladite feuille de verre (1) sur l'ensemble de sa surface en deux phases, dans la première phase, des premiers moyens de bombage (20) pressant la feuille de verre (1) contre le moule (10) à l'exception de la partie de la feuille qui doit être bombée profondément, et dans là deuxième phase, cette dernière partie étant pressée par des deuxièmes moyens de bombage (30) comprenant des buses de soufflage (34) contre la partie du moule (10) qui définit la partie profondément bombée de la feuille de verre bombée finie (1) grâce à un jet d'air comprimé provenant desdites buses de soufflage (34), dans lequel lesdits deuxièmes moyens de bombage (30) comprennent en outre au moins un moyen de support mobile (35) déplaçable entre une position de soufflage avancée et une position d'attente rétractée.

2. Appareil de bombage de feuilles de verre conforme à la revendication 1, comprenant des moyens pour soulever ledit moule (10) dans ledit poste de bombage (ST), des moyens pour maintenir ladite feuille de verre (1) près dudit moule sous l'effet d'une aspiration et des moyens pour actionner lesdits deuxièmes moyens de bombage (30) de manière à les amener dans ladite position de soufflage avancée et à insuffler de l'air comprimé depuis lesdites buses de soufflage (34) jusqu'à ladite feuille de verre lorsque ledit moule est dans la position levée.

3. Appareil de bombage de feuilles de verre conforme à la revendication 1, dans lequel deux jeux de deuxièmes moyens de bombage (30) sont prévus des deux côtés dudit moule (10) au niveau des positions correspondant aux surfaces de bombage profond sur ledit moule

(10).

4. Appareil de bombage de feuilles de verre conforme à la revendication 1, dans lequel ledit moyen de support déplaçable (35) comprend une tige de piston (37a), une barre d'actionnement (38) fixée à l'extrémité inférieure de ladite tige de piston (37a) et s'étendant latéralement, ladite barre d'actionnement (38) soutenant lesdites buses de soufflage (34), et une pièce de liaison reliée de manière pivotante à ladite barre d'actionnement (38) au niveau d'une extrémité et fixée audit moule (10) au niveau de l'autre extrémité, lesdites buses de soufflage (34) venant près dudit moule (10) ou étant séparées de celui-ci lorsque ladite tige de piston (37a) est actionnée.

5. Appareil de bombage de feuilles de verre conforme à la revendication 1, dans lequel lesdits moyens de formage comprennent un dispositif de jet de levage (21) placé au niveau de la partie inférieure dudit poste de bombage (ST) et un dispositif d'aspiration (25) pour créer une force d'aspiration d'air au niveau de la surface de formage dudit moule (10).

6. Appareil de bombage de feuilles de verre conforme à la revendication 1, comprenant des moyens de bombage par pression (50) qui sont actionnés après l'achèvement d'une opération de bombage par lesdits moyens de formage (50) pour presser une partie latérale de ladite feuille de verre (1) afin qu'elle corresponde à ladite surface de bombage profond dudit moule (10).

7. Appareil de bombage de feuilles de verre conforme à la revendication 6, dans lequel lesdits moyens de formage sont intégrés dans lesdits moyens de bombage par pression (50).

FIGURE 1

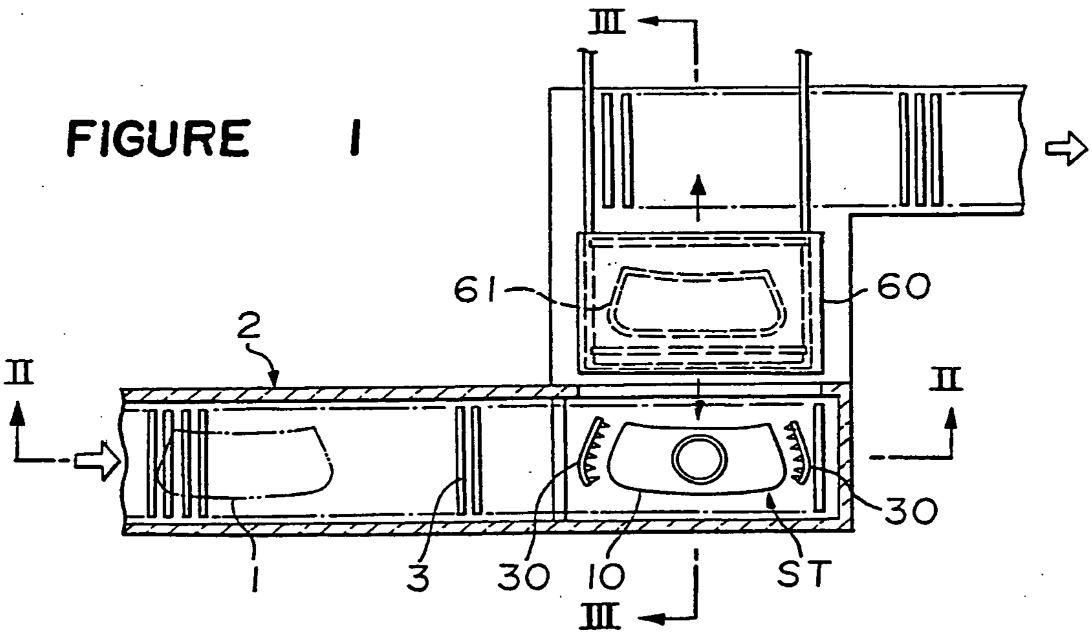


FIGURE 2

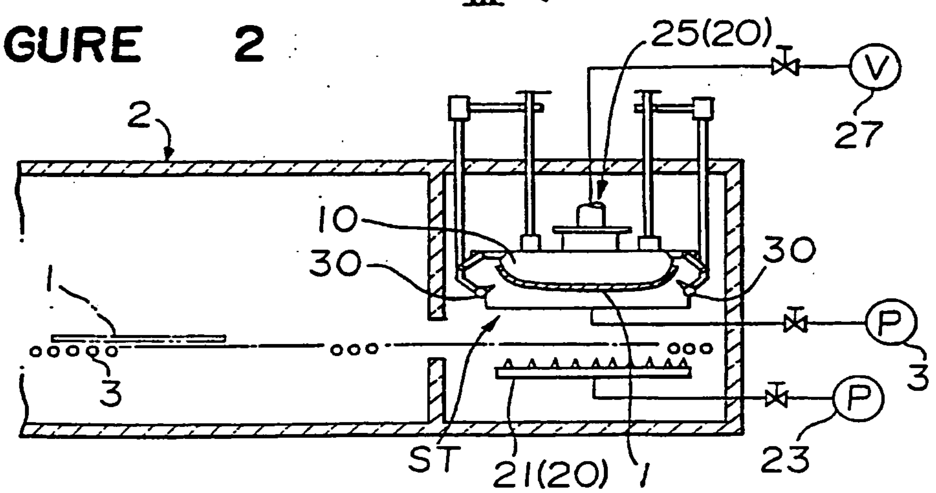


FIGURE 3

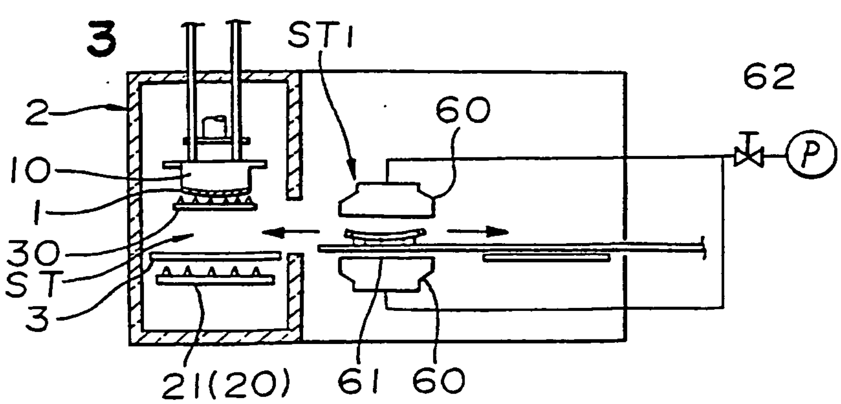


FIGURE 4

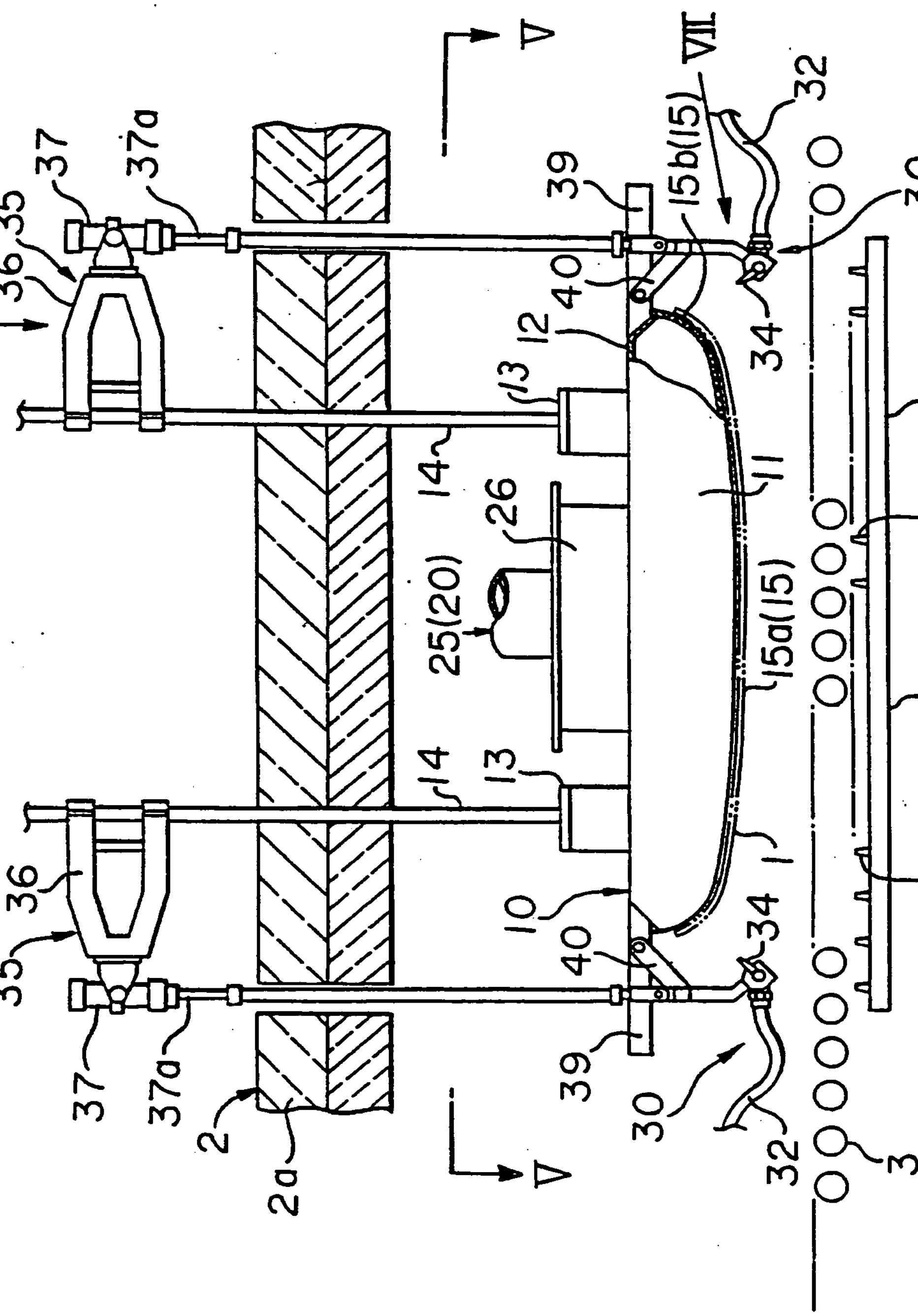

VI
36
35
37
37a
2
2a
V
14
13
10
40
39
30
32
3
25(20)
26
15a(15)
11
12
15b(15)
VII
34
21(20)
22
24

FIGURE 5

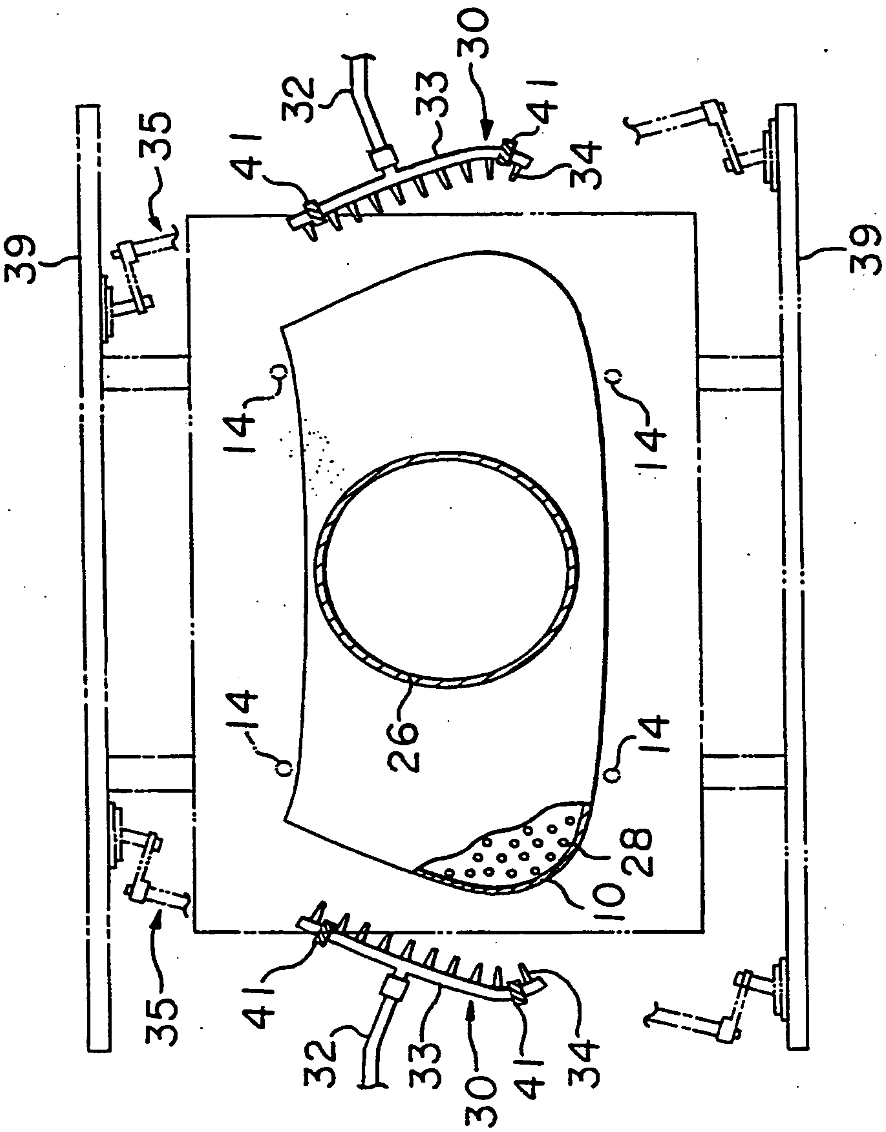


FIGURE 6

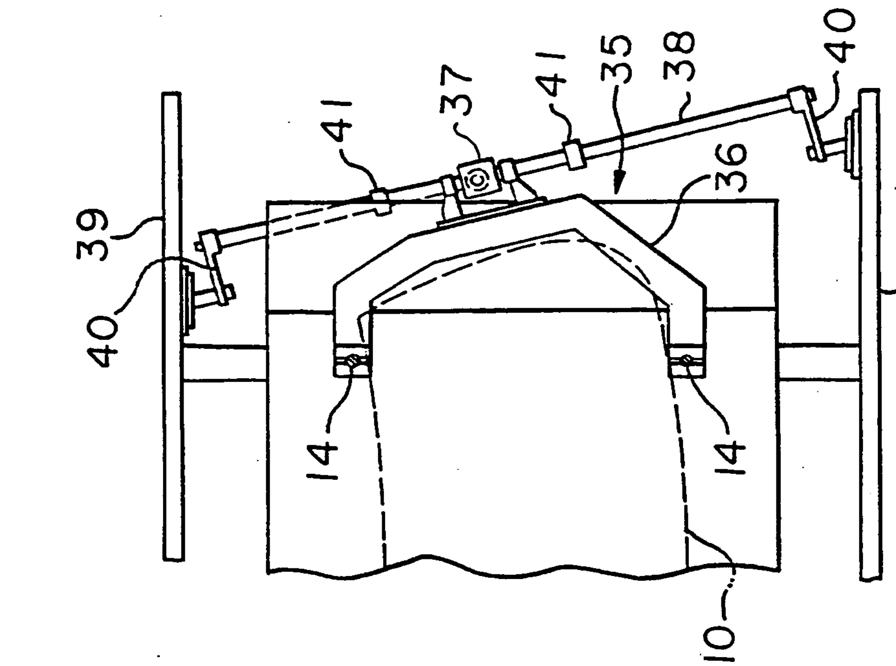


FIGURE 7

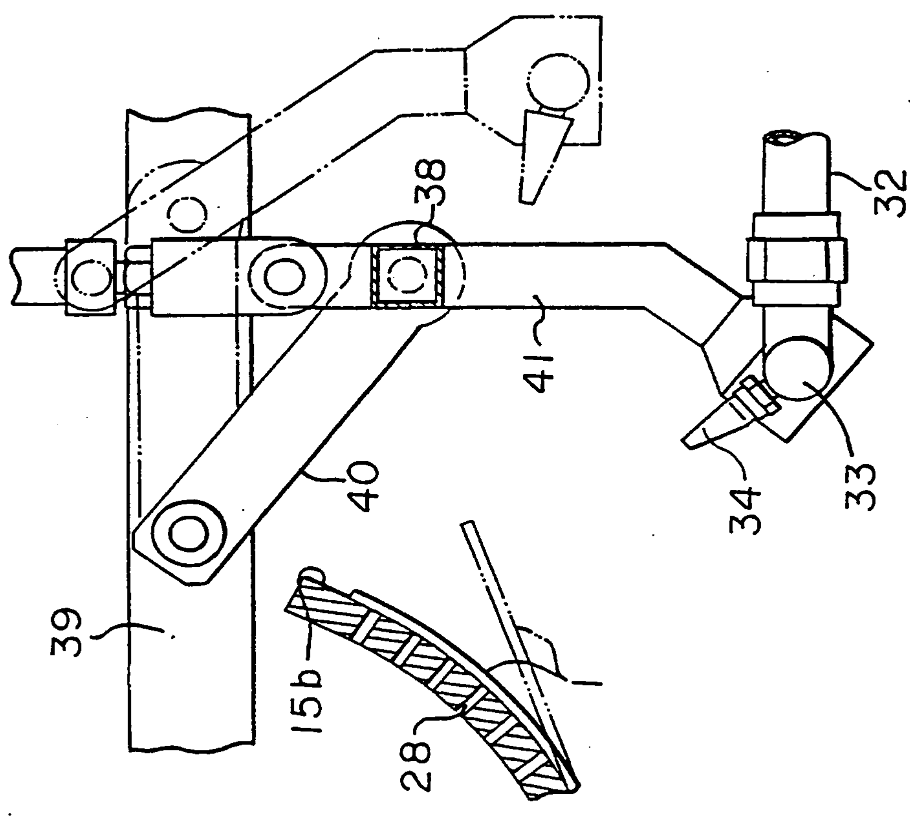
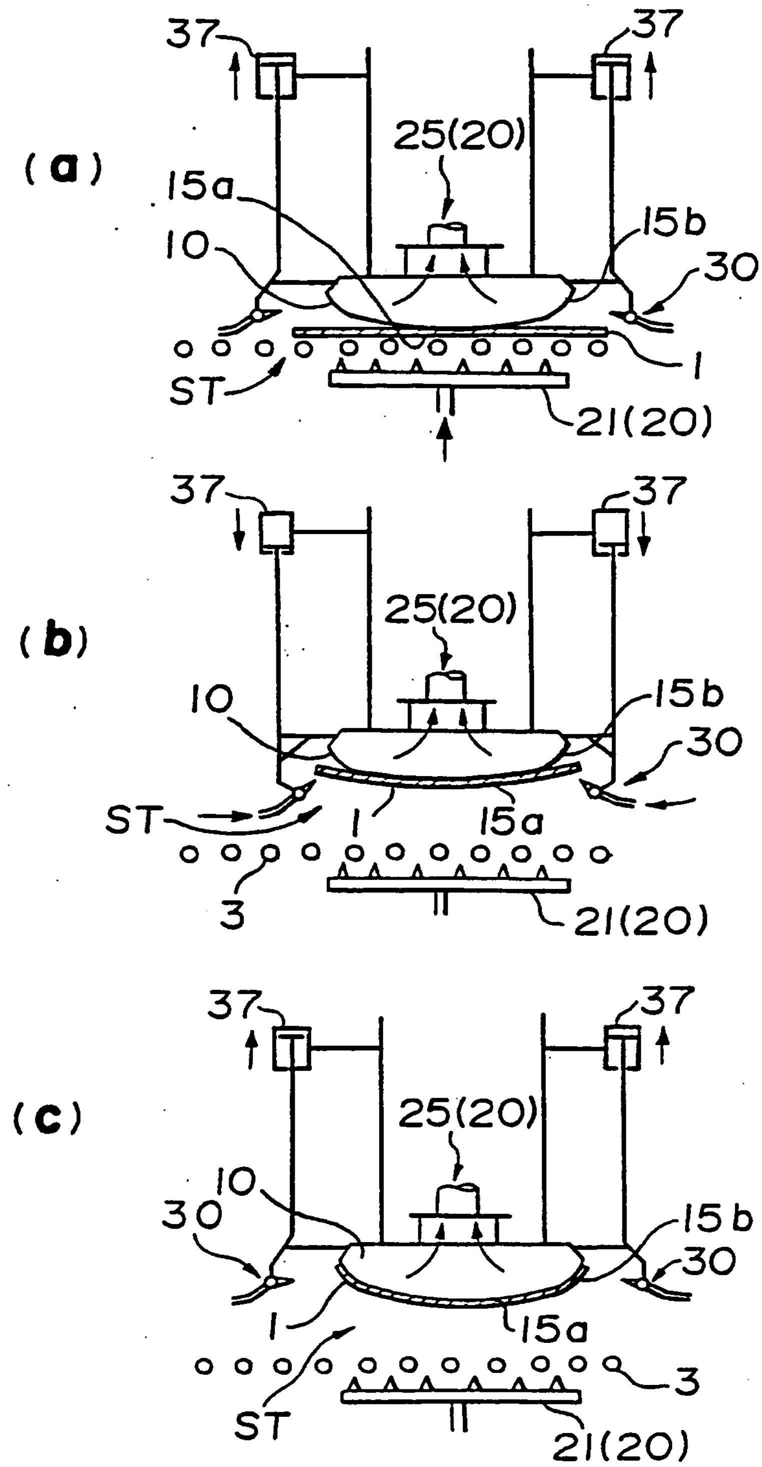


FIGURE 8



(a)
37
37
25(20)
15a
10
15b
30
1
ST
21(20)
(b)
37
37
25(20)
10
15b
30
ST
1
15a
3
21(20)
(c)
37
37
25(20)
10
30
15b
30
1
15a
3
ST
21(20)

FIGURE 9

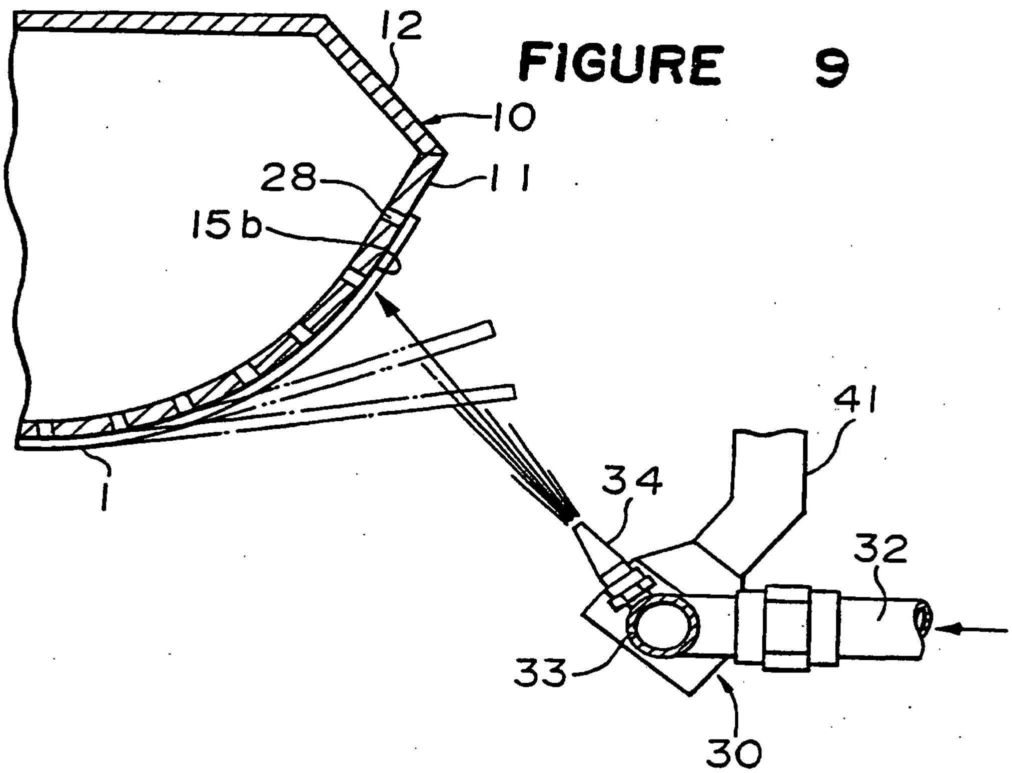


FIGURE 10

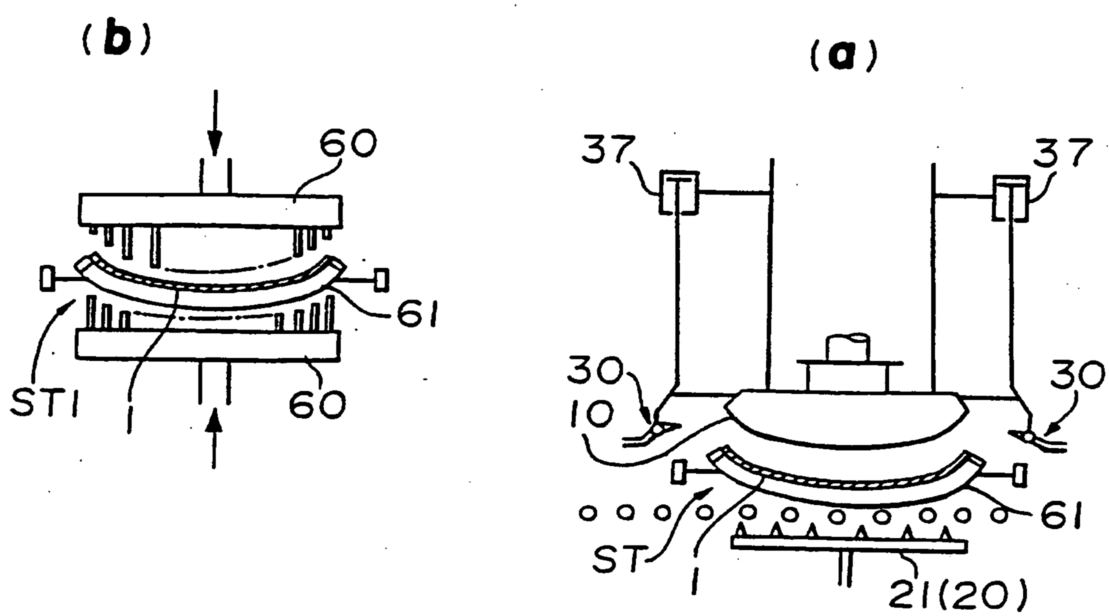


FIGURE 11

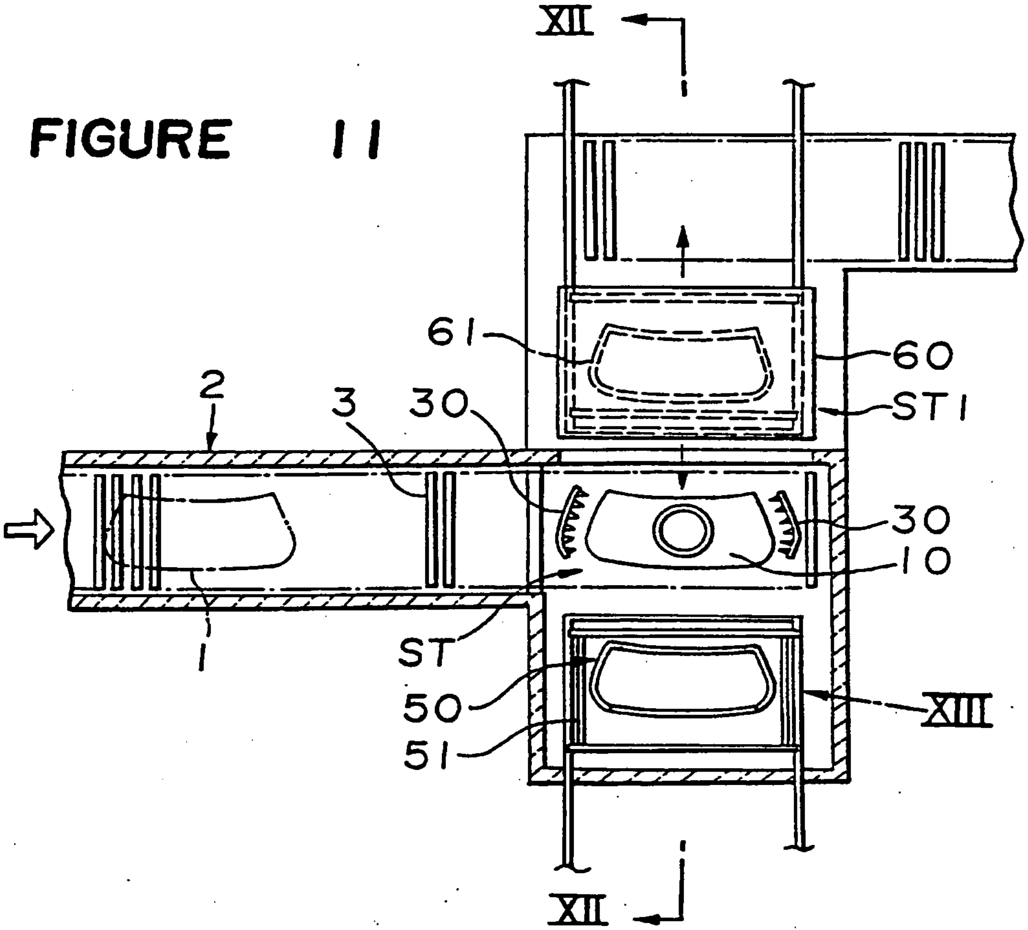


FIGURE 12

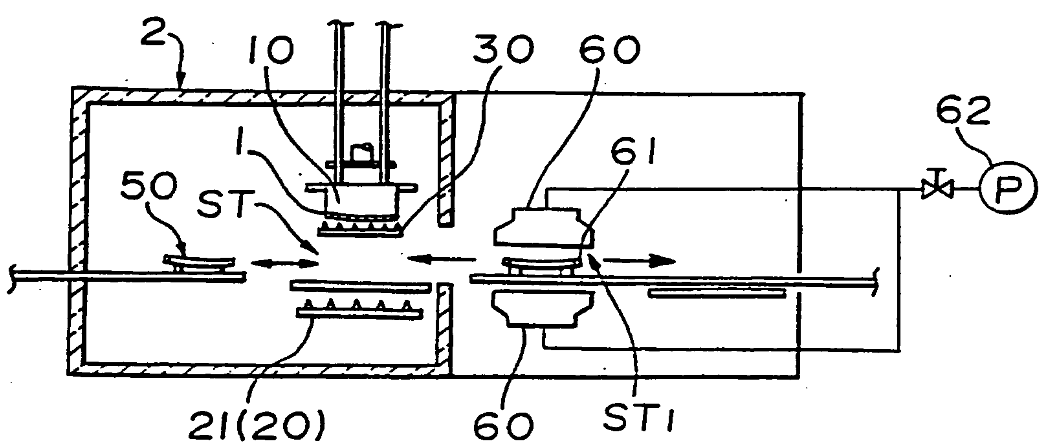


FIGURE 13

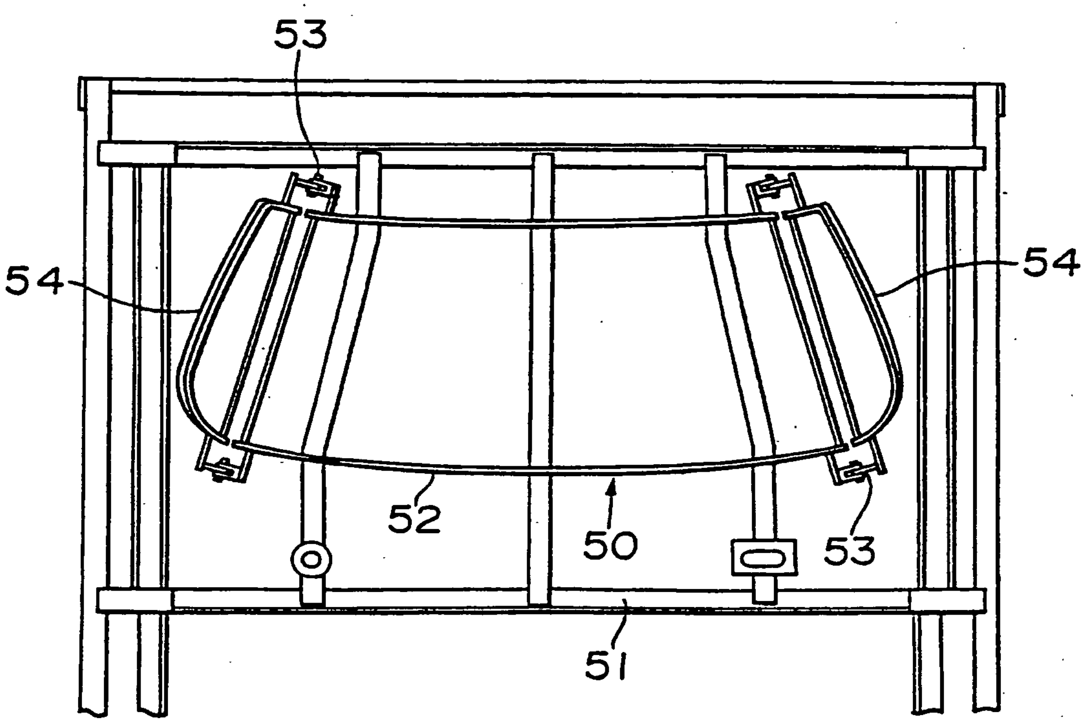


FIGURE 14

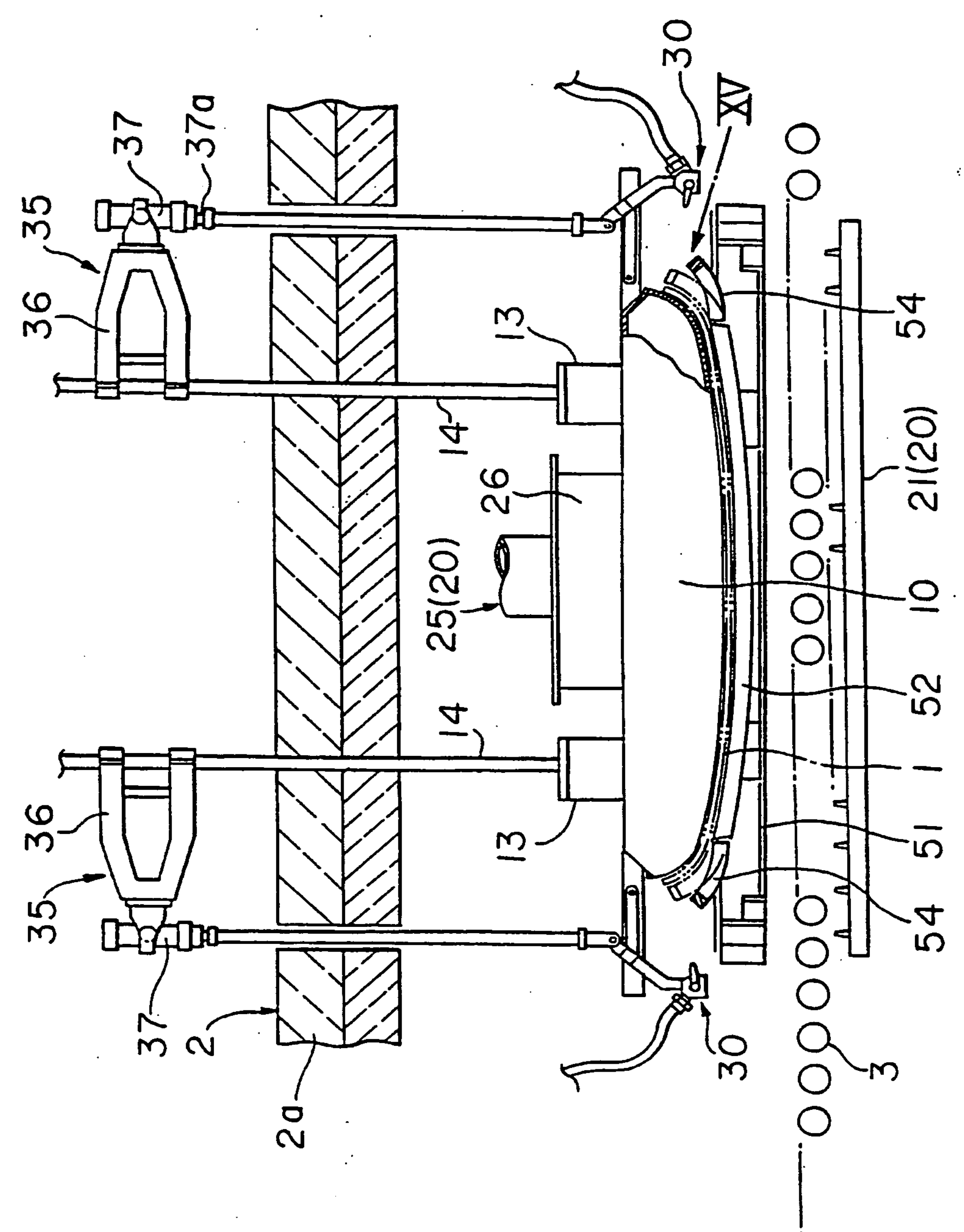


FIGURE 15

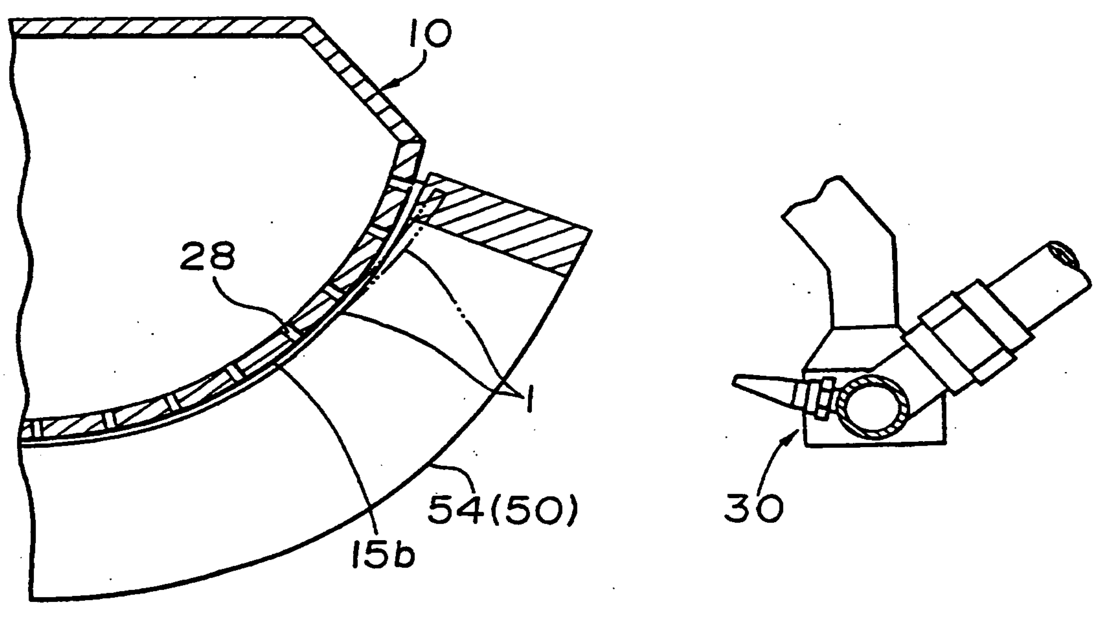


FIGURE 16

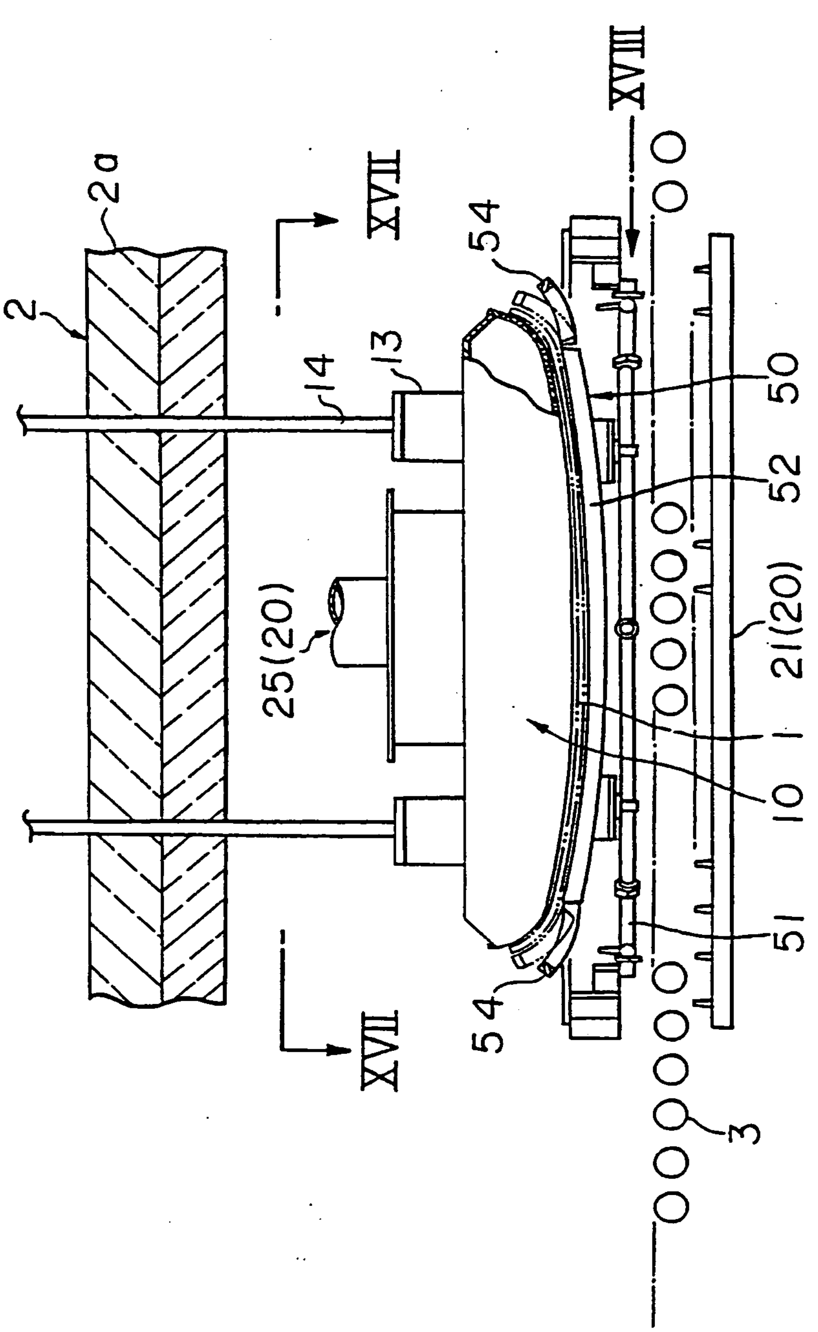


FIGURE 17

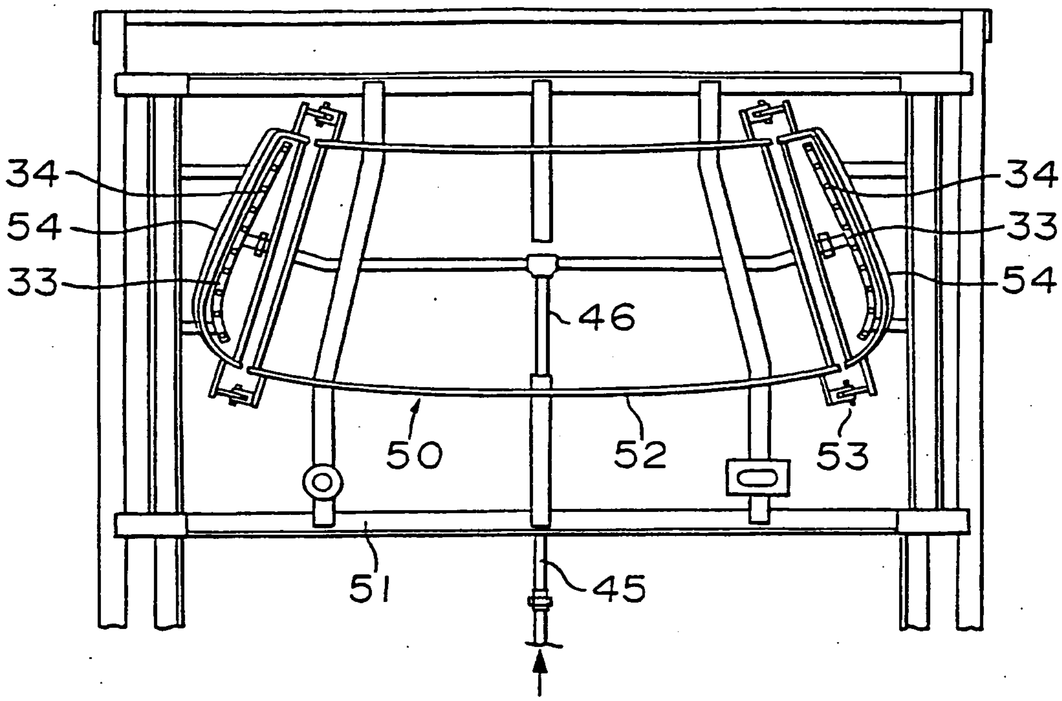


FIGURE 18

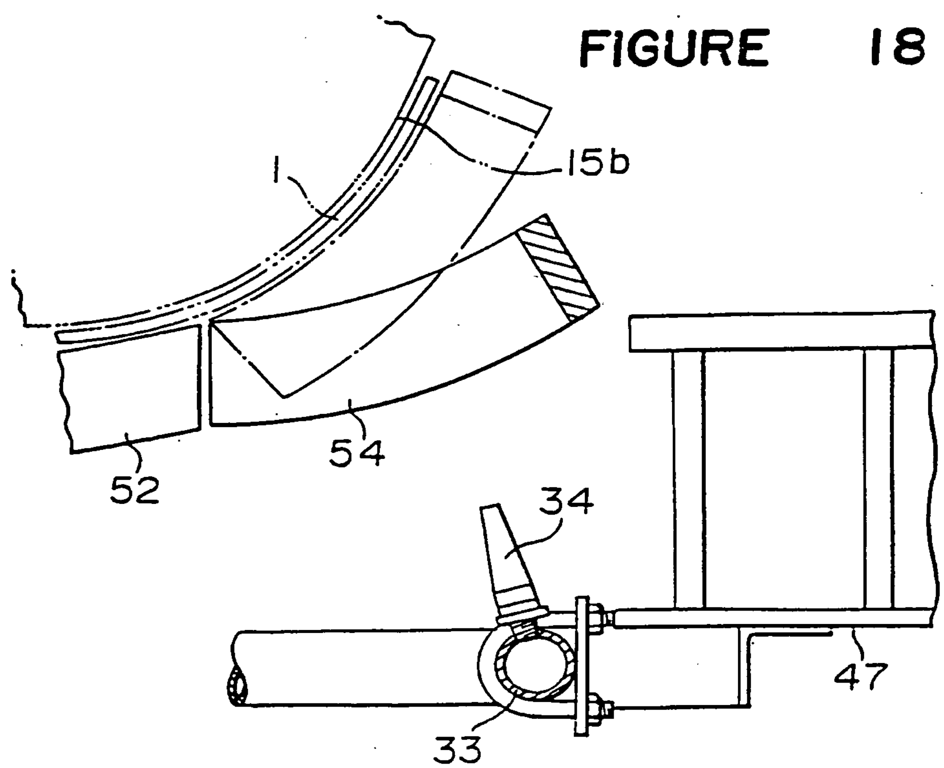


FIGURE 19

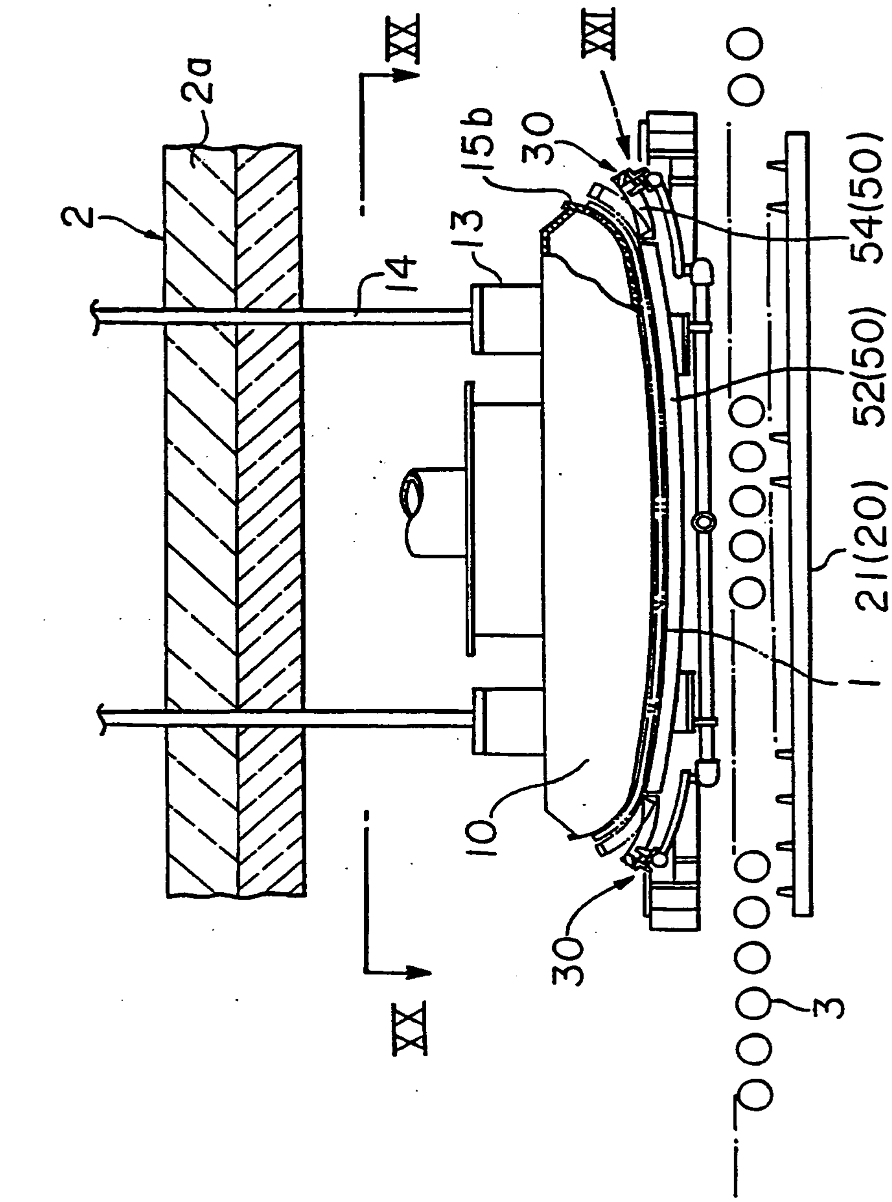


FIGURE 20

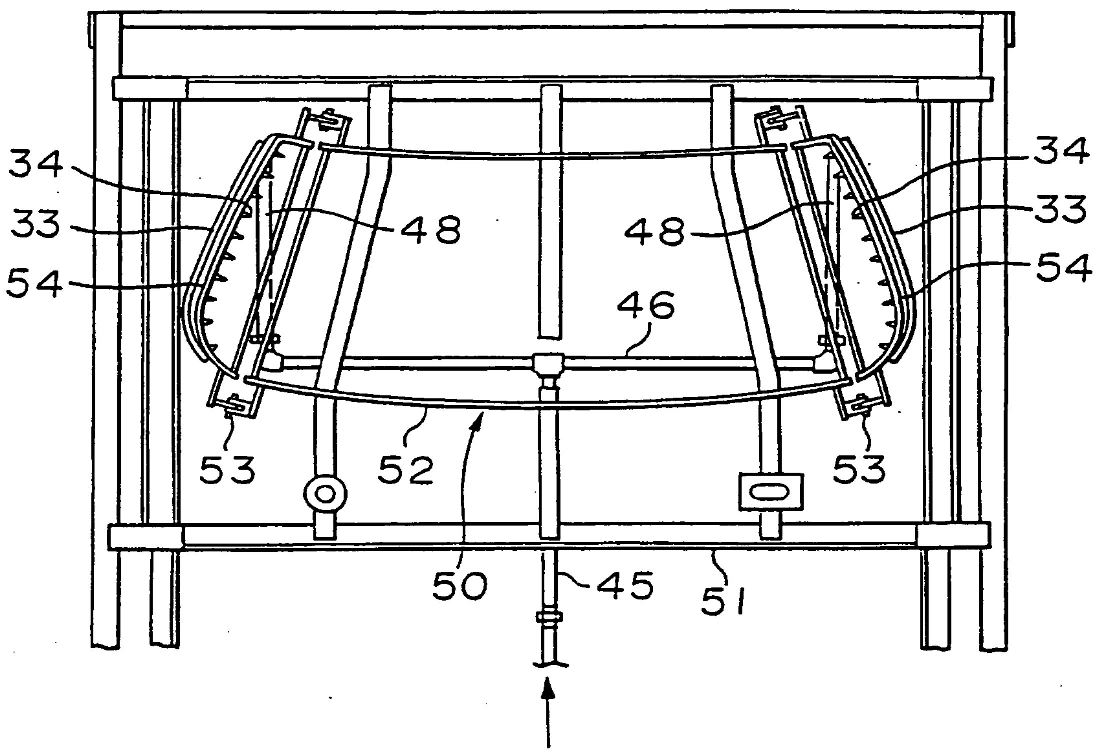


FIGURE 21

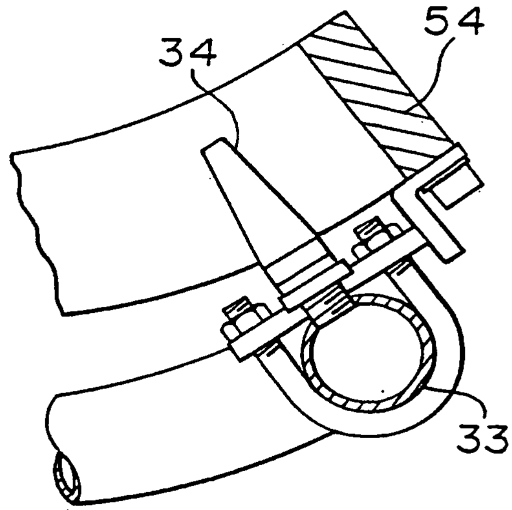


FIGURE 22